mode chip designed in 130 nm CMOS technology [1]. We present results of a PET-ToF demonstrator scanner based on this ASIC and featuring a highly integrated readout and DAQ system.
The Detector Module is composed of 8 matrices of 4x4 LYSO scintillating crystals, each with a size of 3.1 x 3.1 x 15 mm3. These matrices are optically coupled to 8 arrays of Hamamatsu TSV-MPPCs. The crystal matrices and associated MPPCs plug directly in the Frontend Boards forming a compact detecting unit with active area 59x29 mm2. The present results were obtained with a partially assembled ring (16 Modules) corresponding to 2048 SiPM readout channels.
The Frontend board integrates two ASICs allowing the readout and digitization of 128 MPPC pixels. On-chip TDCs produce two time measurements allowing the determination of the event time and of the time-over-threshold. A Concentrator board reads the data from eight Frontend boards (1024 channels) and transmits assembled data frames through a serial link to the PCIe based DAQ board in the data acquisition PC.
At present the PET-ToF demonstrator is fully assembled and in operation (Figure 1). We will report on the detector performance, including energy resolution, spatial resolution, time resolution and rate performance of the system. Images with phantoms will also be presented.

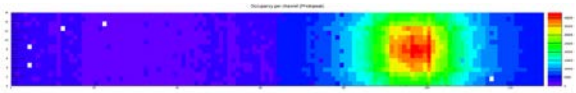

Figure 1 - Flood histogram of the full scanner obtained with a Na22 point source.

References:
[1] M.D. Rolo, R. Bugalho, F. Goncalves, G. Mazza, A. Rivetti, J.C. Silva, R. Silva, and J. Varela. TOFPET ASIC for PET applications. Journal of Instrumentation, 8(02):C02050, 2013.

223

Novel anti-tumour agents targeting the cell membrane

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The cell membrane not only functions as a physical barrier between the intracellular and extracellular space, it harbors critical components involved in receptor-ligand interactions, signal transduction and drug uptake. Targeting the cell membrane represents a novel strategy to improve anti-cancer therapy. Our work focuses on two different approaches. The first involves lipid rafts. These are dynamic, cholesterol/sphingolipid-enriched microdomains within biological membranes, and play a crucial role in the induction of (apoptotic) cell death by radiation, pro-apoptotic receptor agonists and synthetic alkyl-phospholipids.
The second approach addresses insufficient drug delivery into tumor cells, which represents a major limitation of cytostatic therapy. We found that co-formulation and co-administration of liposome-encapsulated chemotherapy and synthetic short-chain sphingolipids (SCS) improves drug availability by enhancing intracellular drug uptake. Specific biophysical requirements of both the SCS (chain length and polarity) and chemotherapeutic agent (amphiphilicity) determine the optimal conditions for improved drug delivery. Doxorubicine and mitoxantrone are two frequently prescribed chemotherapeutic agents that benefit from this cell membrane-targeting approach. In vitro and in vivo studies demonstrate higher drug efficacy and/or lower toxicity in relevant tumor model systems. Mechanistic analyses demonstrate that SCS preferentially insert into tumor cell membranes enhancing the intrinsic capacity to translocate amphiphilic drugs.

Keywords: cell membrane, sphingolipids, liposomes

References:
[1] Van Hell AJ, Melo MN, van Blitterswijk WJ, Gueth DM, Braumuller TM, Pedrosa LR, Song JY, Marrink SJ, Koning GA, Jonkers J, Verheij M. Defined lipid analogues induce transient channels to facilitate drug-membrane traversal and circumvent cancer therapy resistance. Sci Rep. 2013;3:1949.

224

Assessment of MicroDiamond PTW 60019 detector and its use in small radiosurgery fields of Leksell Gamma Knife

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Purpose: Modern radiotherapy is based on using small radiation fields and their segments. For clinical use they need to be verified by measurement. But measurement of small radiosurgery fields is very problematic task because of dosimetry challenges, such as loss of charged particle equilibrium, accurate positioning of detector and its small size. Purpose of this study is to assess new synthetic single crystal MicroDiamond PTW 60019 detector. Its dosimetry characteristics from the manufacturer and especially small size of its sensitive volume (0.004 mm^3) make the detector promising tool for this task.
Materials and Method: In this study basic dosimetry characteristics of MicroDiamond detector were verified in clinical linear accelerator photon and electron beams. Measurements involved short time stability and detector response dependence on dose rate, beam energy, temperature and angular dependence. In addition, measurement of relative output factors for Leksell Gamma Knife Perfexion was performed in order to test dosimeter performance for small fields. Collimator sizes 4 mm, 8 mm and 16 mm were used. Results obtained by this detector were compared with ELEKTA reference values and independent Monte Carlo Geant4 simulation.
Results: Stabilization of detector response was always performed before starting measurement. For this purpose 40 minutes irradiation in reference conditions was necessary (corresponding delivered dose was about 100 Gy). After this time the response was relatively stable with difference between maximum and minimum value 0.25% and standard deviation of all measurements 0.07% within an hour (normalized for this and all subsequent measurements to mean value of response). Dose rate dependence was measured for 6 different dose rates. Difference between maximum and minimum value was 0.24%. Energy dependence of detector was performed for 2 photon energies (6 and 18 MV) and 5 electron energies (6-20 MeV). Difference between maximum and minimum photon beam values was 0.12%, for electron beams this difference was 4.54% with standard deviation of response values 1.62%. Results for temperature and angular dependence are not finalized yet. Finally, results of comparative measurement for relative output factors of the Leksell Gamma Knife for 4 and 8 mm collimators were 0.831 and 0.900, respectively. These values are in a good agreement with vendor values (0.814 and 0.900) and Monte Carlo simulation.
Conclusion: New MicroDiamond PTW 60019 detector appears to be a promising detector for relative output factor measurements in small radiosurgery fields. Verified dosimetric properties of the detector are in limits set by manufacturer. However, relatively long pre-irradiation process is necessary prior to measurement before the detector can produce reliable data. Further measurements will follow. This work was supported by CTU grant no. SGS15/217/OHK4/3T/14.

Keywords: MicroDiamond, small field dosimetry

References:
http://www.ptw.de/2732.html

225